ASTR120 Homework #3 – (Hamilton)
due Thursday Sept. 26 (20 Points)

Finish reading Chapter 4! Now you are cleared for this homework. Try to start early if you can - there are some interesting (but tricky!) problems this week.

*35. A general rule for superior planets is that the greater the average distance from the planet to the Sun, the more frequently that planet will be at opposition. Explain how this rule comes about.

W4. Do problem W4 from http://www.astro.umd.edu/∼hamilton/ASTR120/hw/webexp.html. Pull up the question in one window and the tool in another so you can have both at hand.

40. One trajectory that can be used to send spacecraft from the Earth to Mars is an elliptical orbit that has the Sun at one focus, its perihelion at the Earth, and its aphelion at Mars. The spacecraft is launched from Earth and coasts along this ellipse until it reaches Mars, when a rocket is fired to either put the spacecraft into orbit around Mars or cause it to land on Mars. (a) Find the semimajor axis of the ellipse. (Hint: Draw a picture showing the Sun and the orbits of the Earth, Mars, and the spacecraft. Treat the orbits of the Earth and Mars as circles.) (b) Calculate how long (in days) such a one-way trip to Mars would take.

42. The mass of Saturn is approximately 100 times that of Earth, and the semimajor axis of Saturn's orbit is approximately 10 AU. To this approximation, how does the gravitational force that the Sun exerts on Saturn compare to the gravitational force that the Sun exerts on the Earth? How do the accelerations of Saturn and the Earth compare?

46. A satellite is said to be in a "geosynchronous" orbit if it appears always to remain over the exact same spot on the rotating Earth. (a) What is the period of this orbit? (b) At what distance from the center of the Earth must such a satellite be placed into orbit? (Hint: Use Newton's form of Kepler's third law.) (c) Explain why the orbit must be in the plane of the Earth's equator.

47. Figure 4-21 shows the lunar module Eagle in orbit around the Moon after completing the first successful lunar landing in July 1969. (The photograph was taken from the command module Columbia, in which the astronauts returned to Earth.) The spacecraft orbited 111 km above the surface of the Moon. Calculate the period of the spacecraft's orbit. See Appendix 3 for relevant data about the Moon.

*48. In Box 4-4 we analyze the orbit of Jupiter's moon Io. Look up information about the orbits of Jupiter's three other large moons (Europa, Ganymede, and Callisto) in Appendix 3. Demonstrate that these data are in agreement with Newton's form of Kepler's third law.

*49. Suppose a newly discovered asteroid is in a circular orbit with synodic period 1.25 years. The asteroid lies between the orbits of Mars and Jupiter. (a) Find the sidereal period of the orbit. (b) Find the distance from the asteroid to the Sun.