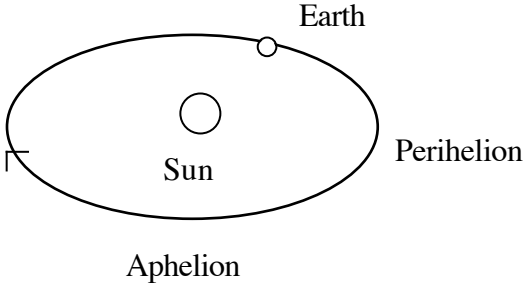
Prof. L. Sparke Astronomy 103 Name_____
Fall 2006 Disc._____

Homework 3: Due **Wednesday, September 27**, in class (or turn them in before then to my mailbox, 5th floor, Sterling Hall). Show your work (for partial credit if you make an arithmetic error).

1. This diagram shows the path of the Earth (seen from the North) around the Sun



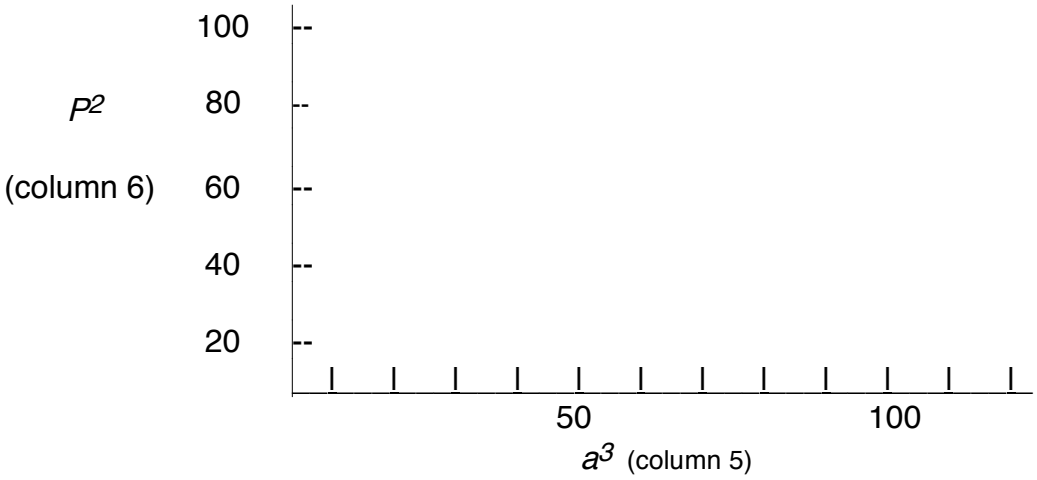
There are several things wrong with this diagram. Draw a correct picture. Mark also the point where the Earth is moving fastest in its orbit, and where it moves slowest.
Extra Credit: Mark the point where it is winter in Madison.

2. Kepler's third law applies to objects orbiting around any star, or a black hole, or another planet. Fill in the table below, for the satellites of Jupiter:

	(1) Distance from planet (thousands of km)	(2) Distance divided by Io distance *(a)*	(3) Period in Days *(P)*	(4) Period divided by Io period	(5) a^3 (column 2)^3	(6) P^2 (column 4)^2	(7) a^3/p^2 (column 5 divided by column 6)
Io	421.6	1	1.77	1			
Europa	670.9		3.55				
Ganymede	1070		7.16				
Callisto	1883		16.7				
Elara	11,737		260				

Because the orbits of Jupiter's satellites are nearly circular, the average distance from the center of the planet is about the same as the semi-major axis *a* of the orbit. What does Kepler's third law say about the numbers in the last column?

Now plot the numbers a^3, P^2 from the first *four* rows of the table on this graph. Your points should lie on a straight line. You can use the graph to check your answers to the questions below.



What would be the semi-major axis (average distance), in kilometers, of a satellite which had a period exactly 1/8 as long as Io?

What would be the period, in days, of a satellite that is 4 times further from Jupiter than Io is?

If a satellite was found at a distance of 1000 000 km from Jupiter, what would its period be?

How far would a satellite have to be from Jupiter to have a period of 10 days?

3. The period P of a satellite (such as the Hubble Space Telescope) circling the Earth in a low orbit is about 90 minutes, and the semi-major axis (radius) a of the orbit is about the same as the Earth's radius, 6400 km. How large is the orbit of an Earth satellite that has a period 8 times as long as this?

What is the semi-major axis (radius) of the orbit if the period is exactly 1 day?

This is a 'geostationary' orbit: as the Earth turns, the satellite stays above the same point on the surface. What are geostationary satellites used for?