

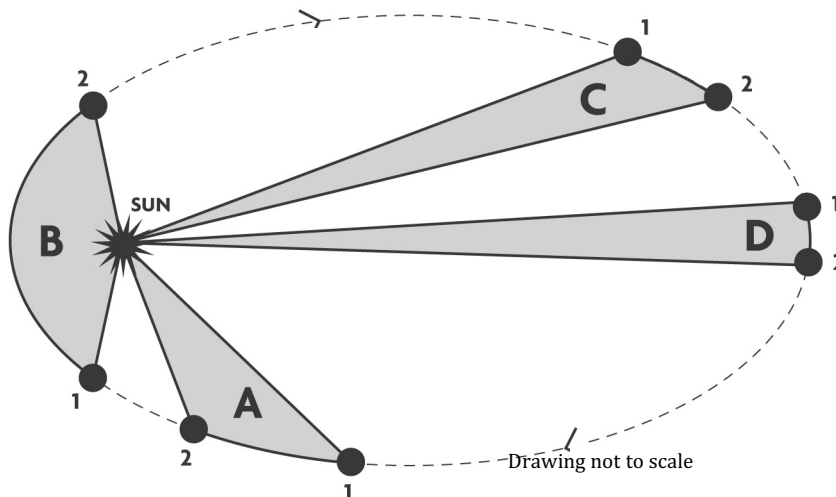
Homework #5

Due at 5pm on Monday, October 16

You may submit Parts 1, 3 and 4 either (a) electronically via Moodle or (b) on paper to my mailbox outside Merrill 213. Do NOT leave under my door or in the boxes outside my office.

Part 1 – Questions

Question #1 - Description: The figure below shows a comet traveling in an elliptical orbit around the Sun. The comet is shown as it moves through four different segments of its orbit (labeled A, B, C, and D). During each segment of the orbit the comet sweeps out the triangular shaped area shaded in gray. Assume each of the shaded triangular shaped areas has the same area.



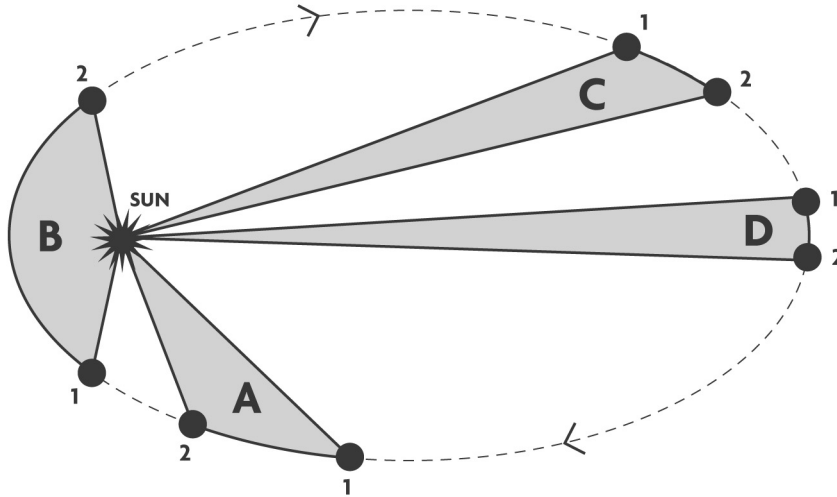
Ranking Instructions:

A. Ranking Instruction: Rank the time it took (from greatest to least) for the comet to move along each of the segments (A – D) of the orbit.

Ranking Order: Greatest 1 _____ 2 _____ 3 _____ 4 _____ Least

Or, the time to travel each segment would be the same. _____ (indicate with check mark).

Carefully explain your reasoning for ranking this way:



B. Ranking Instructions: Rank the distance (from greatest to least) the comet traveled during each of the segments (A – D) of the orbit.

Ranking Order: Greatest 1_____ 2_____ 3_____ 4_____ Least

Or, the distance traveled during each segment would be the same. _____ (indicate with check mark).

Carefully explain your reasoning for ranking this way:

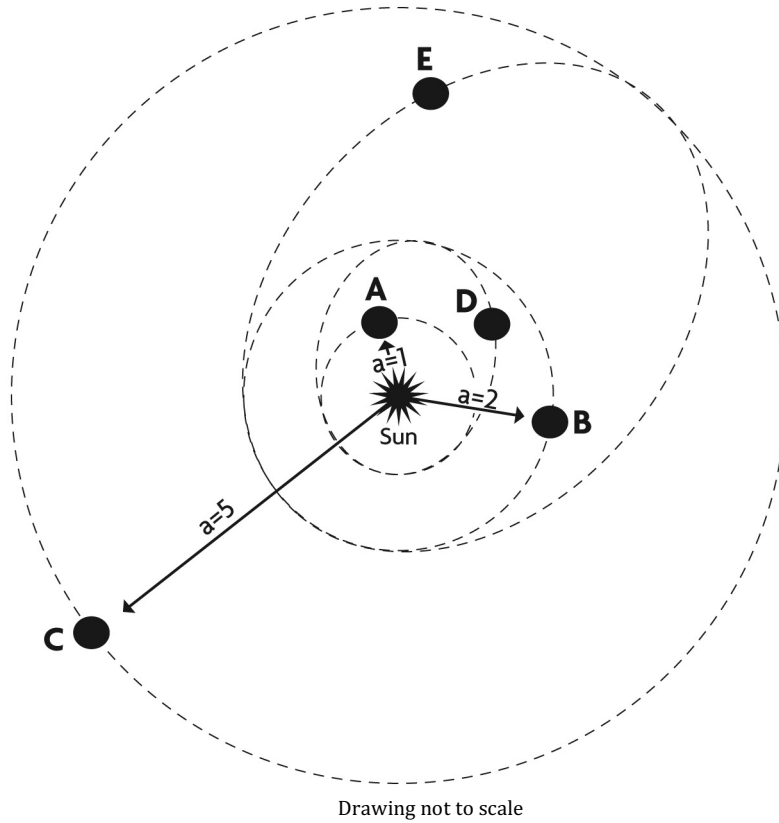
C. Ranking Instructions: Rank the speed (from slowest to fastest) of the comet during each segment (A – D) of the orbit.

Ranking Order: Slowest 1_____ 2_____ 3_____ 4_____ Fastest

Or, the speed of the comet during each of the segments would be the same. _____ (indicate with check mark).

Carefully explain your reasoning for ranking this way:

Question #2 - Description: The figure below shows a star and five orbiting planets (A – E). Note that planets A, B and C are in perfectly circular orbits. In contrast, planets D and E have more elliptical orbits. Note that the closest and farthest distances for the elliptical orbits of planets D and E happen to match the orbital distances of planets A, B, and C as shown in the figure.



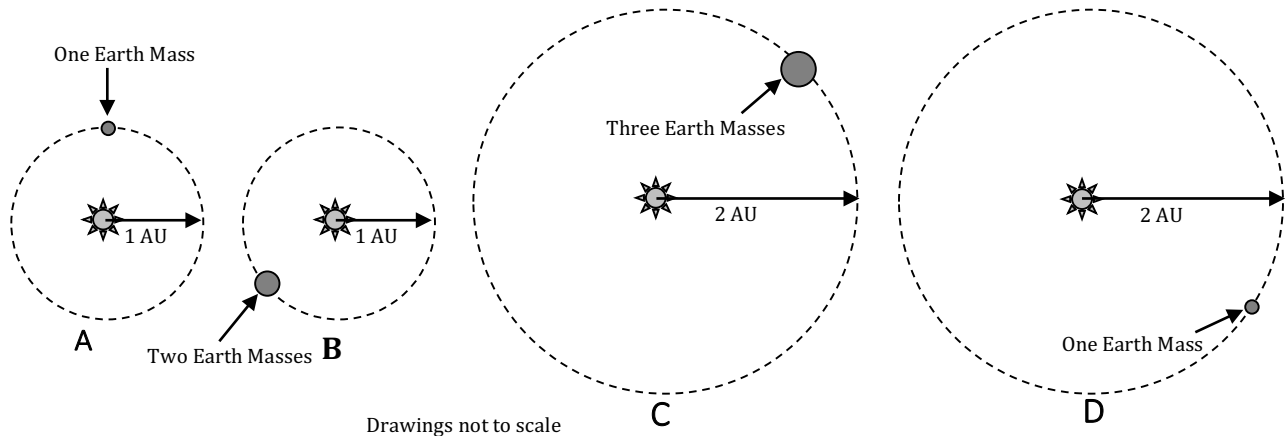
Ranking Instructions: Rank the orbital period (from longest to shortest) of the planets.

Ranking Order: Longest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ Shortest

Or, the orbital periods of the planets would all be the same. _____ (indicate with check mark).

Carefully explain your reasoning for ranking this way:

Question #3 - Description: The figure below shows four identical one solar mass stars, and four planets (A – D) of different masses in circular orbits of various sizes. In each case the mass of the planet is given in Earth masses and the orbital distance is given in Astronomical Units (AU). Note that the sizes of the stars and planets, and the orbital distances have not been drawn to scale.



Using Kepler's Third Law, calculate the orbital period in years for all four planets (A-D).

Explain in words using the equation for Kepler's third law what the equality of the periods for planets A/B and C/D implies and describe whether or not this is surprising to you.

Part 2 – Mastering Astronomy

Please complete this part through the course Moodle page. It's due at the same time as the rest of the assignment.

Part 3 – Checking in

Answer this portion on the same sheet of paper as Part 1.

- What was the most interesting concept that you learned in class last week?
- What was the most difficult concept that you learned in class last week? What is still confusing about it?

Part 4 – Observing

The goal of this week's observing assignment is twofold. You need to observe both the planet Saturn and the Milky Way. As always, you should note the time, date, location and sky conditions on your sketch and draw your REAL horizon, including any obstacles along it. Draw what you actually see, not what you think you should see! Note that you need to be at a pretty dark location (for example, the Book and Plow Farm) to see the Milky Way, so plan ahead and bring a friend. Read the instructions and questions below thoroughly before completing your observation.

Part 1: Observing Saturn

The planet Saturn is in the constellation Ophiuchus (the 13th zodiac sign) this month and is visible just after sunset in the Southwestern sky. Ophiuchus is a hard constellation to pick out, so this week you'll locate Saturn relative to a few easier landmarks. Use your planisphere to find (a) the constellation Saggitarius (it looks a lot like a teapot), (b) the star Antares in the constellation Scorpio (a bright red star, the heart of the scorpion) and (c) the star Altair in the constellation Aquila (the eye of Aquila the Eagle) and sketch the relative locations/orientations of all three relative to your horizon. Saturn will be a very bright star in the same region of the sky, but will not be present on your planisphere. Sketch it's location and label it. Then measure the distance from Saturn to both Altair and Antares and follow the instructions in the questions for recording it. The questions also ask about the relative brightness of Saturn and some of the stars in this part of the sky, so make sure to complete that part of the observation before moving on.

Part 2: The Milky Way

The same field that you sketched in Part 1 also contains a large swath of the Milky Way, which rises like steam from the spout of the teapot-shaped Saggitarius constellation and passes right up through the summer triangle (of which Altair is a part). After letting your eyes adjust for ~10-15min and using red cellophane to cover your light source for sketching so that you don't ruin your night vision, sketch the path of the Milky Way from Saggitarius to the Summer Triangle. It can help to avert your eye a bit and look out of the corner when viewing faint things, so try that trick if you're having trouble. If you still can't see it, you probably need to find a darker site. Once you've located the Milky Way, use fist and finger measurements to estimate both (a) how wide it is on average and (b) what the range in width is across whatever swath you see. Label the widths at at least two locations (the narrowest and widest points in the swath you sketched) in your drawing.

Questions

1. How far was Saturn from Antares and Altair, and how did you arrive at those measurements (how many fists/fingers)?
2. By observing them carefully by eye, rank from brightest to dimmest the apparent brightness of the stars Vega, Altair, Deneb and Antares, as well as Saturn. If any two appear equal in brightness, indicate that as well.

3. Describe in words the degree of variation that you see in the brightness of the Milky Way.
 - a. How uniform in brightness is it?
 - b. Do you see any dark patches? If so, about how big are they?
4. Describe in words the degree of variation in the width of the Milky Way.
 - a. How wide is it on average and how did you determine that?
 - b. What is the approximate degree of variation in the width of the Milky Way and how did you determine that?