Exoplanet Name: _____

Prelab 4: The Path of the Sun

Due Friday, September 28 at the start of class

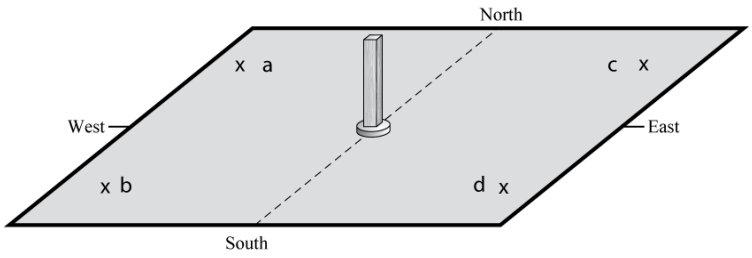
Must be handed in on paper to the assignment inbox

Please write legibly or type your answers. Illegibile assignments will not be graded

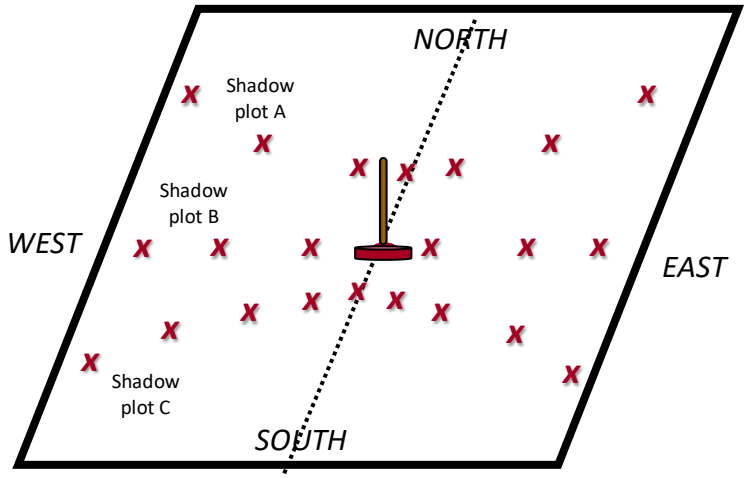
1. The distance between the Sun and Earth is 1.5×10^8 (or 150 million) km.
   The diameter of the Earth is 1.3×10^4 (or 13,000) km.
   a. If you could line up a series of Earths side-by-side, how many Earths would fit between the Sun and Earth? Give the answer rounded to the nearest single earth (no decimal point)
   b. Explain why you think the distance between Earth-Sun seems either crowded or empty by ***discussing*** your answer to part (a). Use only one or two sentences. Be sure you think carefully about the meaning of the word "crowded." *Hint: Consider a more intuitive situation like people in a crowd and make an analogy.*

You may wish to complete the "Path of the Sun" Lecture Tutorial before attempting questions 2-3.

2. Which "X" could represent the position of the end of the stick's shadow made shortly before sunset during the summer? Explain your reasoning.



3. Consider the diagram below, where the stick depicted at its center casts a shadow due to illumination by the sun. That shadow extends from the base of the stick to one of the "x" symbols marked on the plot. Over the course of one day, the tip of the stick's shadow traces out a line across the diagram called a "shadow plot" according to the sun's path through the sky. Three such trajectories are depicted in the diagram (A, B, and C). For ***each*** of the shadow plots depicted (A, B and C), when during the year would a stick's shadow follow this trajectory if observed from Amherst and why? If your answer is "never", explain why and describe where and when an observer on Earth would be able to observe such a trajectory.



You may wish to review the background material on geocentric and heliocentric cosmologies at http://astro.unl.edu/naap/ssm/ssm.html and to play around with the simulators there before answering questions (4-6) below

4. Imagine that you are a future Martian colonist observing the other planets in the solar system move through your (Martian) sky over time.
    a. Explain in your own words how the Earth would appear to move through the sky over the course of a Martian year. Would there be any restrictions in where it would appear in the Martian sky? A diagram (and the "Zodiac strip" in the planetary configurations simulator) may help you to support/formulate your argument.

b. Explain in your own words how Jupiter would appear to move through the sky over the course of a Martian year. Would there be any restrictions in where it would appear? A diagram (and the "Zodiac strip" in the planetary configurations simulator) may help you to support/formulate your argument.

5. Open the planetary configurations simulator and set the two planets to Mars and Earth. Drag them around until Mars is at "superior conjunction" relative to Earth (sun, Earth and Mars will lie along a straight line with the two planets on opposite sides of the sun). Zero the counter and then drag time forward until the planets are once again at superior conjunction.
   a. How long did it take for conjunction to happen?

   b. About how many orbits around the sun do each of the planets go through in that time?

   c. Do the planets always line up in this way at the same location in their orbit around the sun?

   d. Use the equation for the relationship between the synodic period (which you found in a) and the period of Earth to solve for the period of Mars' orbit. Check your answer by looking up the orbital period of Mars.

6. Explain the reason for the following observations in your own words.
    a. For an inferior planet, the planet is not observable at inferior or superior conjunction, while an exterior planet is observable only at inferior conjunction.

    b. Exterior planets always exhibit retrograde motion for a time period that is centered on inferior conjunction.

    c. Interior planets never exhibit retrograde motion.