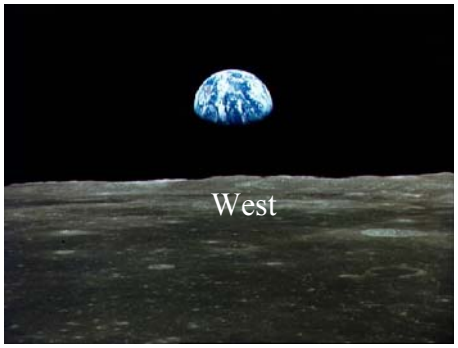
Astronomy 210 Spring 2005
Homework #1
Due in Class: Friday, Jan. 28

Note: Your homework solutions should be legible and include all calculations, diagrams, and explanations. The TA is not responsible for deciphering unreadable or illegible problem sets! Also, homework is graded on the method of solution, not just the final answer; you may not get any credit if you just state the final answer!

1. Viewed from the Moon, the Earth shows phases. This is an image of the Earth taken by the Apollo 11 astronauts. (7 points)



http://nssdc.gsfc.nasa.gov/planetary/lunar/apollo11.html

   a. What phase does the Earth have?
   Is the Earth waxing or waning for an observer on the Moon?

   b. Given this phase of the Earth, what phase does the Moon have to an observer on the Earth?

2. When Mars is at opposition, at what time of day or night will the planet rise? Set? (2 points)

3. The latitude of Champaign-Urbana is 40.11° N. (8 points)

   a. What is the maximum altitude (angular distance) of the Sun above the horizon at vernal equinox, summer solstice, autumnal equinox, and winter solstice here?

   b. Consider a flat surface, area 1 m^2, lying perfectly level on the ground in Champaign-Urbana. It is heated by the Sun. Assume that the radiant flux from the Sun (the energy per unit area per unit time through a surface perpendicular to the direction of the Sun) does not vary with time. This mean radiant flux (the Solar constant) amounts to 1.367×10^3 W m^{-2}. We neglect the small variation in distance from Earth to Sun over the course of the Earth's orbit. More about that later in the course. Use your answer to (a) to calculate the net solar power (energy/time) through our 1 m^2 surface when the Sun is at maximum altitude above the horizon at each of the four times of the year considered in part (a). Does this help explain the seasons?

   c. Qualitatively, in what direction does the Sun rise and set (N, NE, E, SE, S, SW, W, NW) at each of the four times of the year considered in part (a)?

4. (6 points)
   a. The angular speed of the Sun's eastward motion with respect to the stars is about 1 degree per day. Show this.

   b. Calculate the angular speed of the Moon's eastward motion with respect to the stars.

5. One day, as you walk out of this class, you see the moon <u>just</u> rising in the East. What is the moon's phase on that day? (3 points)

6. Suppose that in a heliocentric model, the stars were located on a true celestial sphere in the form of a "shell" at a radius of 10 AU. If two stars, located in the plane of Earth's orbit, are observed to be 8° apart when the Earth is closest to them, how far apart will they be when the Earth is on the side of its orbit farthest from them? Would this difference be observable to the naked eye? Comment on the implications for the heliocentric vs geocentric debate. *Hint:* You may use the small angle approximation for this calculation. (6 points)

7. In the following image, estimate how long the camera exposed the film to get the long arc? (3 points)

http://antwrp.gsfc.nasa.gov/apod/image/0205/planets1_orman.jpg

8. Based on your reading from Ferris, chose Ptolemy, Brahe, Copernicus, or Galileo and describe in less than 1 page (typed) their cosmology of the Universe. What were some of the strengths and weaknesses (during their time) of their cosmology? Make sure to include examples. (15 points)