Homework #2

Due Sept. 20

1. A physics 101 student is standing on the east side of a building, and notices that it casts no shadow. One hour later, she notices that the shadow of the building is about 3 feet long. Approximately how high is the building she is standing next to?

2. Ancient astronomers know that the motion of the stars in the sky is more regular than the motion of the sun. Give an example of a simple observation you could make with no equipment at all (not even a timekeeping device) that illustrates this. *Hint:* you may need a lot of time on your hands.

3. Copernicus posited that the earth spins on its axis, rather than the stars orbiting around a stationary earth. Knowing the size of the earth, a contemporary of Copernicus could have computed the speed of a point on the surface of the earth compared to the earth's center. (Recall that the radius of the earth had been measured already in ancient times.) Compare this to the speed of a galloping horse. How could this have been used by a contemporary of Copernicus to make his ideas seem implausible?

4. One of the major scientific objections to Copernicus' theory was the absence of stellar parallax. Suppose that the most accurate measurement of the angles that define the position of a star was good to $\frac{1}{2}^\circ$ in the time of Copernicus. How far away would the stars have to be compared to the earth-sun distance to explain the absence of observed stellar parallax in Copernicus' theory?

5. One of Copernicus' new results was an estimate of the distance to Mars. Since Mars' orbit is outside the earth's he could not use the simple method he used for Mercury and Venus. This problem is about one possible method to determine the distance to Mars, using the fact that a Martian year is 687 earth days. We can observe Mars when it is "in opposition" to the sun, *i.e.* it is directly overhead at midnight. Then we can observe the position of Mars in the sky 687 days later. Explain how measuring the angle between Mars and the sun on that day allows us to find the ratio of the Mars-sun distance to the earth-sun distance.