Feel free to discuss these problems with classmates, but write up your work independently. Put your name and discussion section on this and any additional sheets of paper and staple them together. Show your work for full credit. Use scientific notation when appropriate.

1.  (4 pts) Eratosthenes Redux

Suppose that Eratosthenes had found that at Alexandria at noon on the summer solstice the Sun was $20^\circ$ south of the zenith. What value would he have found for the Earth’s circumference, in units of stadia?

2.  (6 pts) Eclipses

   a) What phase is the moon at a solar eclipse? A lunar eclipse?

   b) Briefly explain why solar and lunar eclipses do not occur every month. A sketch is worth a thousand words!

   c) Occasionally there are no solar eclipses in a year. Briefly explain how this could be.

3.  (10 pts) Parallax: The False Proof of a Geocentric Universe

Aristotle argued that the Earth did not go around the Sun because if it did we would observe the stars to show the parallax effect. Let’s explore this idea a bit.

   a) Look at Figure i) on the back page. If you were to walk from A to B, all the while looking at Tree C, briefly describe what you would see. How would Tree C appear to move relative to the more distant trees? This apparent motion is the parallax effect.

   b) Now look at Figure ii) on the back page. If the Earth and you were to move from A to B in 6 months, and all the while you were looking at Star C, briefly describe what you would see. How would Star C appear to move relative to the more distant stars?

   c) In Figure iii), the angle $\alpha$ is known as the parallax angle. This angle is a measure of how far a nearby star would appear to move because of the Earth’s motion. If the distance from the Earth to the Sun is $1.5 \times 10^8$ km and the distance to the nearest star is $3 \times 10^{13}$ km, how large is $\alpha$ in degrees and arcseconds?

   d) Briefly discuss whether Aristotle’s argument was correct or not, and why. For comparison to your parallax angle, remember that the moon’s diameter is $0.5^\circ = 30$ arcmin $= 1800$ arcseconds.

4.  (2 pts) Sample Exam Question: Circle the correct choice.

At what location on the Earth’s surface would you, over one year, see the most stars? (Presume the clarity, etc. of the night sky is the same everywhere.)

   a) The North Pole
b) Somewhere on the equator.
c) Madison
d) Mt. Everest, the highest elevation.
e) Over one year, every place on Earth sees the same number of stars.

5. (3 pts)

Briefly explain the reasoning behind your answer to question 3.