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. **(8 pts) The Ptolemaic Universe**

Show with diagrams how the Ptolemaic geocentric models explained:

   a) daily motion
   b) solar motion
   c) retrograde motion of the planets
   d) Venus never being more than 46° from the sun in the sky

2. **(8 pts) The Copernican Universe**

Show with diagrams how the Copernican heliocentric model explained:

   a) daily motion
   b) solar motion
   c) retrograde motion of the planets
   d) Venus never being more than 46° from the sun in the sky

3. **(6 pts) The Spherical Earth**

You live in the Dark Ages. Approached by a Flat Earth believer, you are challenged to defend your conviction that the Earth is spherical. Give, with brief explanation, two astronomical observations that prove the Earth is spherical. (Give more for extra credit and intellectual victory!)

Here “astronomical” means that the argument incorporates a celestial observation.

4. **(6 pts) Galileo’s Observations**

In a few words, explain the significance of each of these discoveries of Galileo with his telescope.

   a) Discovery of Jupiter’s moons
   b) Phases of Venus (in particular, full phase)
   c) Sunspots

5. **(2 pts) Sample Exam Question: Circle the correct choice.**

Hipparchus introduced the idea of the “eccentric circle” in order to explain his observation that

   a) The location in the sky of the North Celestial Pole had changed over time.
   b) The length of the year had changed over time.
   c) The rate of the Sun’s motion in the sky was greater in the winter than in the summer.
   d) The phases of the Moon.
e) The planets occasionally move from west to east in the sky (“retrograde motion”).

6. (3 pts)

Briefly explain the reasoning behind your answer to question 5.