29:61 General Astronomy
Fall 2012
First Hour Exam . . . September 19, 2012

Write legibly. Start each question on a new page. It allows me to make comments and generally keeps me in a better mood. Explain what ideas you are using and what you are trying to do. There are 8 questions. Notice that they differ in the number of points. Fundamental physical and astronomical constants are given at the end. Good luck and no whining.

Walk with Ursus!!!

(1) I am telling you about a long trip that I took around the world. I say that one night, I looked up and saw the bright star Capella (α Aurigae) straight overhead at the zenith. *With only this information*, what can you say about my location on Earth when I made the observation? Give a number for it. The Equatorial coordinates of Capella are $\alpha = 5$h 17m, $\delta = 46°$. (5pts)

(2) Explain what is meant by the term "circumpolar stars". Explain why the stars one sees as circumpolar depends on the latitude. (5pts)

(3) What is the term for the intersection of the orbital plane of the Earth with the celestial sphere? (5pts)

(4) Of the major planets, which ones do we see at opposition, and which ones are never seen at opposition. Give a brief reason for your choice. (5pts)

(5) In a few days, what will be the approximate Right Ascension and Declination of the Sun? What is the name we use for the part of the sky where the Sun will be this weekend? (5pts)

(6) A minor planet is orbiting the Sun on an orbit with major axis = 4 astronomical units and an eccentricity of 0.50. At *aphelion* (furthest point in its orbit from the Sun) is it moving with an angular speed of 1°/month. **This is the angular speed that an observer in an inertial reference frame outside the solar system would observe, not an observer on Earth**. What is the angular speed when the minor planet is at *aphelion* (closest point to the Sun in its orbit?). Explain your reasoning and clearly show all equations and diagrams. (10pts)

(7) An train is traveling north at a speed of 65 miles/hour (105 km/hour). Over a period of 5 minutes, it gradually turns to the west through a bend until it is moving due west. What is the *average* acceleration of the train during this time? Remember that velocity is a vector and you must express the acceleration as a vector. You can consider the EW direction as the the x axis and the NS direction as the y axis, or you may choose your

own coordinate system. **Note:** for this problem, you may used mixed units for the final answer, or you may express the result in SI units. (10pts)

(8) What is the orbital speed of Saturn as it moves in its orbit around the Sun? You may approximate Saturn's orbit as circular, and its semimajor axis a is 9.54 astronomical units. (10pts)

Fundamental Physical and Astronomical Constants

- Properties of the Sun: mass = 1.989×10^{30} kg, radius = 6.96×10^{5} km.
- Properties of the Earth: mass = 5.974×10^{24} kg, radius = 6378 km.
- Properties of the Moon: mass = 7.35×10^{22} kg, radius = 1738 km.
- Astronomical Unit: 1.496×10^{11} meters
- The gravitational constant, $G = 6.6720 \times 10^{-11}$ N-m^2-kg^{-2}.
- Boltzmann's constant, $k_B = 1.381 \times 10^{-23}$ m^2-kg-s^{-2}-K^{-1}.
- The speed of light in vacuum, $c = 2.998 \times 10^{8}$ m-s^{-1}.