Astro 102/104 **The Nature of the Universe** **Spring 2008**

Name: Solution Section:

Homework 1: Scientific Notation, the Celestial Sphere, and Orbits

1. (2 points) **Scientific Notation**. Very large or very small numbers are often encountered in astronomy and physics. Scientific notation provides a convenient way to write such numbers and makes the relative sizes of numbers obvious. In this course, you'll express large and small numbers using scientific notation.

a. Express the following numbers in scientific notation:

i. 12,300,000,000

$1.23x10^{10}$

ii. 0.0000000887

$8.87x10^{-8}$

b. Rewrite the following list of numbers in scientific notation:

One million, one billion, one trillion, ten trillion, one-hundred quadrillion, one millionth, one billionth, one-hundred millionth.

10^{6} , 10^{9}, 10^{12}, 10^{13}, 10^{17},10^{-6},10^{-9},10^{-8}

2. (2 points) **Simple Unit Conversions**. All physical quantities (*i.e.* speed, temperature, acceleration, etc.) must have a unit associated with them. The value of a physical quantity is meaningless without the attached unit. Always label your answers with appropriate units. **An answer without the correct units is wrong.**

a. Convert 30.3 m (meters) to km, mm, and nm (you may have to look up what this means). Express your answer in scientific notation.

30.3 m = $3.03*10^{-2}$ km, $3.03*10^{4}$ mm, $3.03*10^{10}$ nm

b. How many days, hours, minutes and seconds are there in a year? Express your answer in scientific notation.

There are:

$3.65 *10^{2}$ days

$8.77 *10^{3}$ hours

$5.26 *10^{5}$ minutes

$3.17*10^{7}$ seconds

in a year.

3. (2 points).

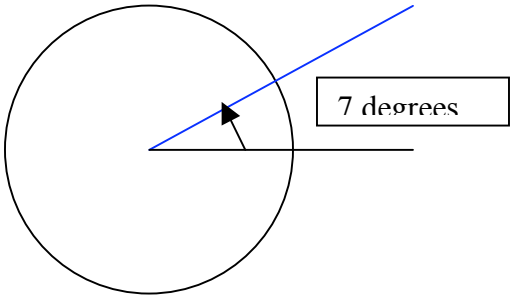
a. Is it possible, using any means necessary (perhaps a spaceship) to reach the celestial sphere? Explain your answer.

No, the celestial sphere is just an abstraction. All of the stars, because they're so far away from the Earth, appear to be located in a shell.

b. If you were to travel to Alpha Centauri, would you see a celestial sphere there? Would it be the same as the one you'd see from Earth? Explain.

Yes. No, it would be different. For one, the Sun would be a point of light in the sky.

4. (2 points). Briefly describe (with a picture and a few sentences) Eratosthenes' method for measuring the circumference of the Earth.



Eratosthenes measured the angle the angle the sun's shadow made on the ground at two different spots on the earth on the same day of the year. Knowing the angle, the distance between the points and the some trigonometry, Eratosthenes was able to determine the circumference of the earth. For a full explanation, refer to the Special Topic on page 68 of your text.

5. (2 points). Using the data from your text (appendix E. Table E.2), pick your favorite planet (or sub-planet) other than Earth and verify Kepler's Third Law. For full credit you must show your work.

Here, I'll use Mars. The orbital period is 1.881 years. The semi-major axis length is 1.524 AU. If you plug this into Kepler's third law:
$(\text{Period})^2 = (\text{Semi-major Axis})^3$

You'll find that both sides are equal, and Kepler's third law holds.