Astronomy 162 – Winter Quarter 2007
Homework #1

Due in class Tuesday, January 16

Instructions

This handout is just a worksheet. Homework answers must be turned in on the bubble sheets provided. You can pick up additional bubble sheets during class.

Using a #2 pencil only (no pens), please fill out the following info:

1. Your full name, **last name** first, first name last, and remember to bubble in the letters.
2. Bubble in your answers under questions 1-5 in the fields provided on the form.
3. There is no need to bubble in any ID numbers

No late homework will be accepted.

This homework assignment consists of the 5 questions below + 1 extra credit problem at the end. The non-extra-credit problems have equal weight.

1) A star has a parallax of 0.01 arcseconds. What is the distance to the star?

   a) 0.01 parsecs
   b) 1 parsec
   c) 100 parsecs
   d) 100 light-years

2) Two stars are the same size. One star has a temperature of 8,000 K and the other has a temperature of 4,000K. Compared to the cooler star, the hotter star must be

   a) 2 times more luminous and redder
   b) 2 times more luminous and bluer
   c) 16 times more luminous and redder
   d) 16 time more luminous and bluer

3) The rest wavelength (λ_{em}) for a hydrogen line is 656.3 nanometers. In the spectrum of a star, you observe this line at 656.4 nanometers. What is the speed and direction that the star is moving (pick the closest answer) ?

   a) 46 km/s, moving towards you
   b) 46 km/s, moving away from you
   c) 0.00015 km/s moving towards you
   d) 0.00015 km/s moving away from you

4) Two stars are in a binary system. If the mass of the first star (M1) is bigger than the mass of the second star, which of the following is true? (hint: a handy animation to watch can be found at www.astronomy.ohio-state.edu/~pogge/Ast162/Movies/#visbin courtesy of Dr. Pogge.)

   a) The orbital period of star 1 is less than the orbital period of star 2.
   b) The orbital period of star 1 is greater than the orbital period of star 2.
   c) The speed of star 1 is less than the speed of star 2.
   d) The speed of star 1 is greater than the speed of star 2.

5) The Sun suddenly collapsed to a radius 100 times smaller. If its mass does not change, what happens to the escape velocity from the surface of the Sun?
   a) The escape velocity is now 100 times smaller.
   b) The escape velocity is now 10 times smaller
   c) The escape velocity is now 10 times larger.
   d) The escape velocity is now 100 times larger.

EXTRA CREDIT PROBLEM

Your answer to this problem must be written up on a separate sheet of paper and handed in on Tuesday, January 16, in class. Please show all your work. Working together is encouraged; however copying someone else's work is not allowed. Up to 1 extra credit point will be awarded for this problem (partial credit will be given.)

Finding the distance to the Sun from the Earth.

Ideally, we would like to bounce radio waves off of the Sun, measure how long it takes them to get there and back, and use the speed of light to find the distance to the Sun. Since the Sun is a ball of gas and doesn't reflect radio waves well, this idea will not work. However, we can bounce radio waves off of Venus and then use Kepler's Third Law to find the Earth-Sun distance. You may use the information below, and only the information below, to find the Earth-Sun distance.

Time for radio waves to reach Venus and return when Venus is directly between the Earth and the Sun is 275.97 seconds.

The speed of light is 2.99792458×10^5 km/s

It takes the Earth 365.25 days to travel once around the Sun.

It takes Venus 224.7 days to travel once around the Sun.

Kepler's Third Law: $P^2 = \frac{4\pi^2}{GM_{sun}} a^3$

Where P is the period, G is the gravitational constant, and M_{sun} is the mass of the Sun (note it should be $M_{sun}+M_{planet}$ but M_{planet} is so small that it can be ignored). The semi-major axis, a, is the Earth-Sun distance if the period of the Earth's orbit is used, Venus-Sun distance if the period of Venus' orbit is used.

Using just the information above, calculate the Earth-Sun distance. There are some hints below.

(a) How many kilometers separate Earth and Venus when Venus is directly between the Earth and Sun?

(b) Form a ratio $\frac{P_{earth}}{P_{venus}}$ and use it to eliminate M_{sun} from the problem.

(c) Relate the distance between Venus and the Sun to the distance between the Earth and Sun (what you want to solve for) and the distance between Earth and Venus (what you know).

(d) Solve your equations! You should get an answer close to 149,600,000 km =1 astronomical unit.