AST103 HW #3 Answer Sheet Spring 2008
Due Wednesday March 26th in class

1) (50%) Starry Night: (You are welcome to do this problem in pairs, as I'm aware that several of you either don't have the program, or can't get it to run on your machine). Assume you are observing from Madison for all these except part B, where you will really observe from whichever beach you may happen to be sitting on over break.
Part A, on computer using starry night.

a) How many constellations of the ecliptic can you see **all** of on March 12th 2008 at 8pm CDT? 5: Aries, Taurus, Gemini, Cancer, Leo. How many can you see part of? 6: Pisces, Aries, Taurus, Gemini, Cancer, Leo, Virgo

b) What time does Alpha Aquarii rise and set on September 21st? (rise: 4:48 PM, set 4:50 AM) December 21st (rise: 10:51 AM, set 10:53 PM) (both 2007). What is the best day in 2007 to observe this star. September 3rd (plus minus 2 days) Why? Highest transit, in the sky the longest. What time does Alpha Geminorum rise and set on October 31st? (rise: 9:19 PM, set 2:00 PM) December 21st (rise: 5:59 PM, set 10:39 AM) (both 2007). What time does Epsilon Geminorum rise and set on October 31st? (rise: 9:06 PM, set 12:32 PM) December 21st (rise: 5:45 PM, set 9:12 AM) (both 2007).

d) How many stars in the constellation Gemini are brighter than 4th magnitude? 14 brighter than 4.5th magnitude? 21 Brighter than 5th magnitude? 27

e) When will Saturn rise and set on March 12th 2008? (rise: 5:00 PM, set 6:32 AM)What constellation is Saturn in? Leo What is the projected angle between Saturn and Regulus? (about 4 degrees 4 minutes) What are their relative brightnesses (magnitudes) (0.27, 1.34)

Part B: Now find a dark night to go out and actually look at Gemini. Let your eyes adjust to night vision for a few minutes before doing the following questions. Be sure to write where you are observing from and what time you went out:

f) How many stars that make up the stick figure of Gemini can you see? Where are you observing from? Hint: You should print out your Gemini plot and take it with you to compare, and to help find the constellations.

2) (25%) You observe two stars, star A and star B. Star A is observed to have a peak wavelength of 5800K, star B is observed to have a peak wavelength of 9800K.
a) What is the Luminosity of star A?
b) What is the Luminosity of star B?
c) How much brighter is star B than star A?

3) (25%) If star A is locate at 10 Parsecs, how far away must star B be for the two stars to have the same *apparent brightness*?

Extra Credit: (5%). Write down a new acronym for the stellar sequence on the H-R diagram?

#2 Note: The problem should state that star A has a surface temperature of 5800K, star B has a surface temp of 9800K.

a) Since we don't know the radius of the star, I'll calculate the flux ($\frac{\text{Watts}}{m^2}$)

$$\text{flux} = \sigma T^4 = 5.67\times10^{-8}\ \frac{W}{K^4 m^2}\cdot(5800K)^4$$

$$= 6.42\times10^{7}\ \frac{W}{m^2}$$

b) $$\text{flux} = \sigma T^4 = 5.67\times10^{-8}\ \frac{W}{K^4 m^2}\,(9800K)^4$$

$$= 5.23\times10^{8}\ \frac{W}{m^2}$$

c) Here, I'll compare the flux from $1m^2$ of each ★

$$\frac{\text{flux}_B}{\text{flux}_A} = \frac{5.23\times10^{8}\ \frac{W}{m^2}}{6.42\times10^{7}\ \frac{W}{m^2}} = 8.15;$$

★ B is 8.15 times brighter than ★ A

#3 Recall $b = \frac{L}{4\pi d^2}$,

use the flux from the previous Problem for L_A & L_B, and you know $d_A = 10pc$ from problem

we want $b_A = b_B$, so $\frac{L_A}{4\pi d_A^2} = \frac{L_B}{4\pi d_B^2}$

substitute in what you know & cancle the 4πs

$\frac{L_A}{d_A^2} = \frac{L_B}{d_B^2}$, cross multiply

$L_A d_B^2 = L_B d_A^2$

$d_B^2 = \frac{L_B}{L_A} d_A^2$

$$d_B = \sqrt{\frac{L_B}{L_A} d_A^2} = \sqrt{\frac{5.23\times10^{8}\ \frac{W}{m^2}}{6.42\times10^{7}\ \frac{W}{m^2}}\,(10pc)^2}$$

$d_B = 28.5pc$