Homework #3 Answers

1. Here's the sunspot numbers

September 21 Sunspot number = **68**
September 22 Sunspot number = **79**
September 23 Sunspot number = **95**
September 24 Sunspot number = **86**
September 25 Sunspot number = **145**

a. Average sunspot number for this time span = **94.6**

b. Reading the graphs can be challenging with the background color, but the peak for cycle 23 occurred during **2000 or 2001.**

c. Cycle 22 had its peak in **1989 or 1990.**

d. The number of sunspots at the peak of cycle 23 was about **240-250.**

e. The current cycle had a peak of around 150 spots. This is approximately **100 fewer spots** compared to cycle 23. Note: The peak is not the value you determined in part a, that's just the number averaged over one week.

f. Cycle **19** had the highest peak (1954-1965)

g. With the current cycle's peak being 150 spots, **10 cycles** had lower peaks. 13 cycles would have higher peaks.

h. You know, I just realized that the two graphs have different values graphed on the vertical axis (averaged over different time spans), so comparing them isn't really fair. I'm going to give everyone credit for parts g and h which required you to compare the data on the two graphs. Sorry about that.

2. Since you all had different stars, there is no single answer. So I'll provide 3 different answers.

B3 Alkaid, T=17,600 L=1060	G1 58 Eridani T=5930 L=1.1	K5 epsilon Indi T=4400 L=0.15

a. Wiens' law is $\lambda = 0.0029/T$

$\lambda = 0.0029/17600$ $= 1.65 \times 10^{-7}$ m	$\lambda = 0.0029/5930$ $= 4.89 \times 10^{-7}$ m	$\lambda = 0.0029/4400$ $=6.59 \times 10^{-7}$ m

b. The table in the "Light and Telescope" notes can provide the answer, using either the wavelength given above or the black body temperature.

Ultraviolet	Visible	Visible (just barely)

c. First, divide each temperature by 5800 to put it in terms of the Sun's temperature.

17600/5800 = 3.03 5930/5800 = 1.02 4400/5800 = 0.76

Now put the values into the L-R-T formula

$1060 = R^2\,(3.03)^4$ $1.1 = R^2\,(1.02)^4$ $0.15 = R^2\,(0.76)^4$
$1060 = R^2\,(84.3)$ $1.1 = R^2\,(1.08)$ $0.15 = R^2\,(0.33)$
$R^2 = 1060/84.3 = 12.6$ $R^2 = 1.1/1.08 = 1.02$ $R^2 = 0.15/0.33 = 0.45$
And take the square root (since the value above is R^2)
R = 3.55 R = 1.01 R = 0.67
These are in units of the sun's radius. Your value may be slightly different due to rounding.

d.Calculate the mass, using $L=M^{3.5}$, which needs to be solved for M, so take the (1/3.5) root of both sides to get $M = L^{(1/3.5)} = L^{0.29}$.

$M = 1060^{(0.29)} = 7.3$ $M = 1.1^{(0.29)} = 1.03$ $M = 0.15^{(0.29)} = 0.58$
These are in units of the Sun's mass. Your value may be slightly different due to rounding.

3. The easiest way to handle this for part d, and e is to make an HR diagram of the stars, which can be done by comparing these types to figures 6 or 7 in the stars notes, or even the table of values for stars that was used for question 2 of the homework.

Star Name	Spectral Type	Apparent magnitude	Parallax shift (arcseconds)
Rosish	M1 I	9.87	2.91×10^{-6}
Marthania	M1 V	5.10	6.10×10^{-5}
Donoble	F2 V	6.13	4.17×10^{-4}
Amelium	M1 III	8.76	1.87×10^{-6}
Riverius	A3 V	3.39	3.11×10^{-3}
Clarion	B4 White Dwarf	12.4	0.772

a. The brightest star in the sky would be the one with the lowest value of apparent magnitude, or **Riverius.**

b. The one that is the greatest distance from Earth would be the one with the smallest parallax shift, which in this case would be **Amelium** (that value is smaller than the shift for Rosish).

c. The highest temperature would be the one earliest in the sequence OBAFGKMLT, so **Clarion.**

d. The supergiants win this contest, so the highest energy output is from **Rosish.**

e. The largest radius star would be located in the upper right corner of an HR diagram, so **Rosish** fits that criteria. It has the same temperature as Marthania and Amelium, but the higher luminosity is due to its larger radius.