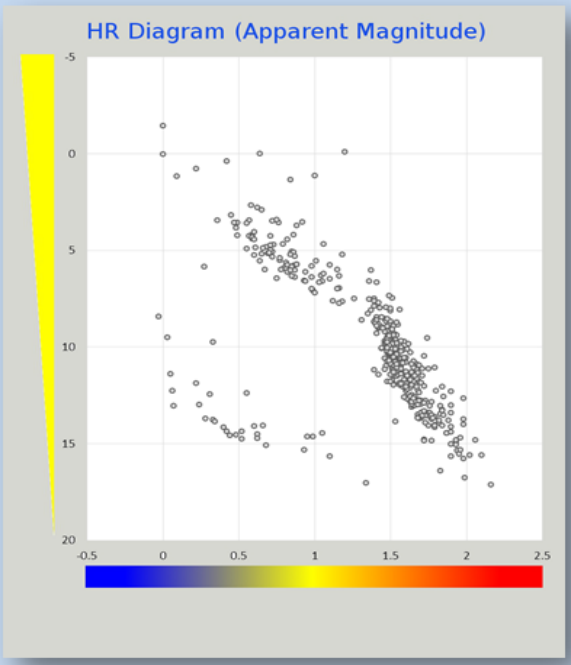
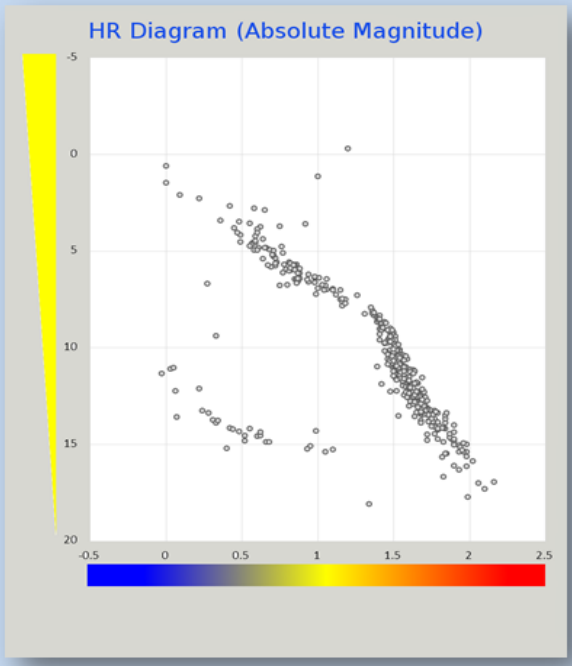
Stellar Classification HR1

Question 1





1. What type of stars occupy the bottom left of your HR diagram?

The bottom left of the Absolute Magnitude HR Diagram is dominated by white dwarfs that are the cores of Sun like stars where they have ejected their outer layers and have been compressed to a size comparable to the Earth.

2. What is the spectral classification and ID number of the brightest star on your diagram?

Chart	*Identifier*	*m*	*M*	*Spectral Classification*
Apparent	1111	**-1.43**	**1.47**	**A1v**
Absolute	2349	**-0.1**	**-0.3**	**K2 III EP**

3. What type of star is this?

From the charts above the brightest apparent star (1111) is a type A1v, It resides on the main sequence with a surface temperature of about 10,000˚K and a mass approaching 2xʘ. On the Absolute HR diagram the brightest star is a type K2 III EP (2349). The III indicator means that it is off the main sequence with a "Giant" classification and the EP designator indicates that the Emission lines have peculiarities

4. What is the spectral classification and ID number of the reddest star on your diagram?

Star 1202 has the highest B-V index (Reddest) of 2.16 and it has a stellar classification of M6.5. As this is the the only data supplied it is not possible to say anything more about it. *

5. Identify the regions of the main sequence which are occupied by stars of different spectral types. Which of these spectral types appears to be most common? List each region with the appropriate spectral types and range of absolute magnitudes.

See Over

* The stellar classification for this star has no more data other than the given M6.5 - I have tried to find evidence for giving stars a classification between two integers i.e. M6 and M7 but have been unsuccessful. I realise that the M classification occupies the greatest amount of space on the B-V scale but is it in order split a category i.e. 6.5 or has the .5 another significance? - Thanks Stacey

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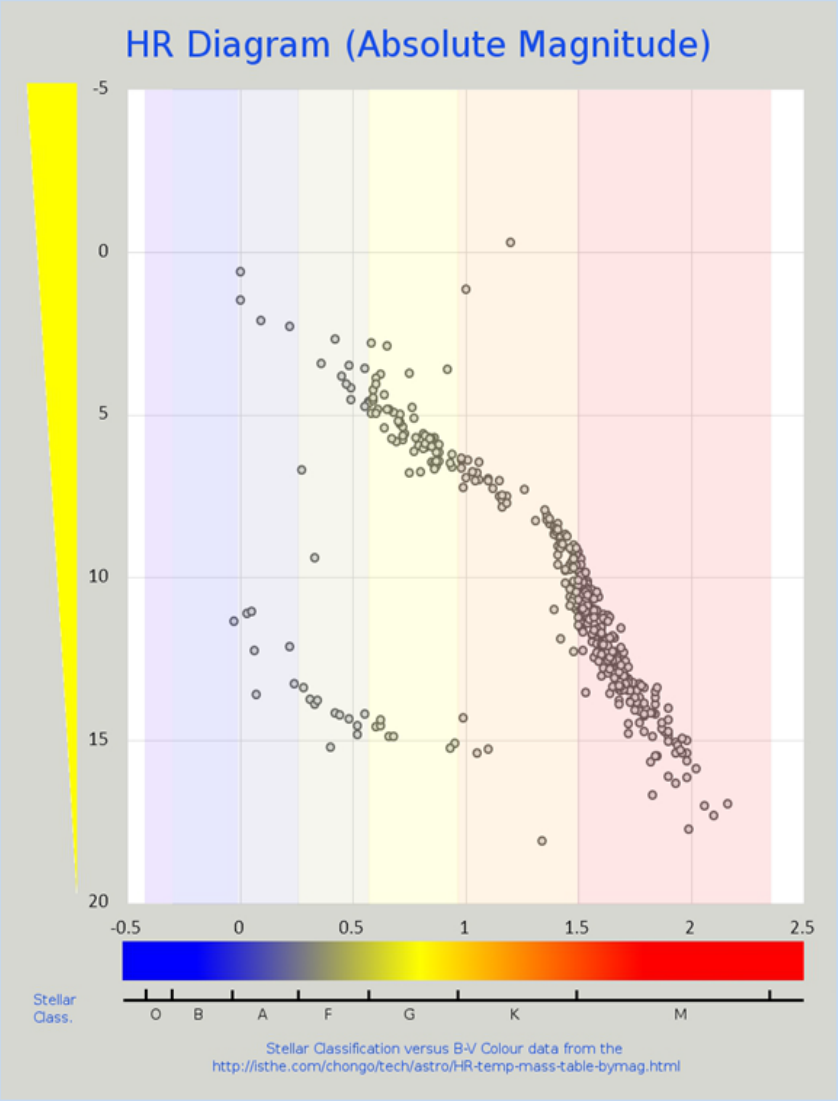
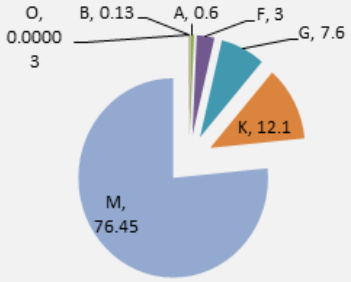


Spectral Class	B-V index	M max
O0v	-0.35	-5.9
O5v	-0.33	-5.4
B0v	-0.29	-3.7
B5v	-0.22	-1
A0v	-0.06	0.6
A5v	0.05	1.9
F0v	0.3	2.6
F5v	0.46	3.4
G0v	0.63	4.3
G5v	0.79	5.2
K0v	0.96	5.9
K5v	1.2	7.2
M0v	1.49	9
M9v	2.39	19

The above data was extracted from the http://isthe.com/chongo/tech/astro/HR-temp-mass-table-bymag.html web site

Spectral Class	Fraction in MS(%)
O	0.00003
B	0.13
A	0.6
F	3
G	7.6
K	12.1
M	76.45

Graph



The above data was extracted from the http://en.wikipedia.org/wiki/Stellar_classification web site

Of the data tables available the one that generated the HR diagram above is probably the most representative (The Composite diagram that follows is heavily weighted towards the brighter and therefore more massive stars) The M class stars dominate by far the galaxy makeup and prove conclusively that it is easier to make a small star than it is to make a big one. Indeed recent research suggests that groups L and T (Smaller and less massive than M class stars and too small to start nuclear fusion in their core) are even more populous. On the diagram the various spectral types are shown in colour bands and it shows that there are two main groups on the main sequence, one hotter than F8v and one cooler than K5v between F8v and K5v. I suspect that it may be because the sample data is not big enough and that if it were then this gap would be filled.

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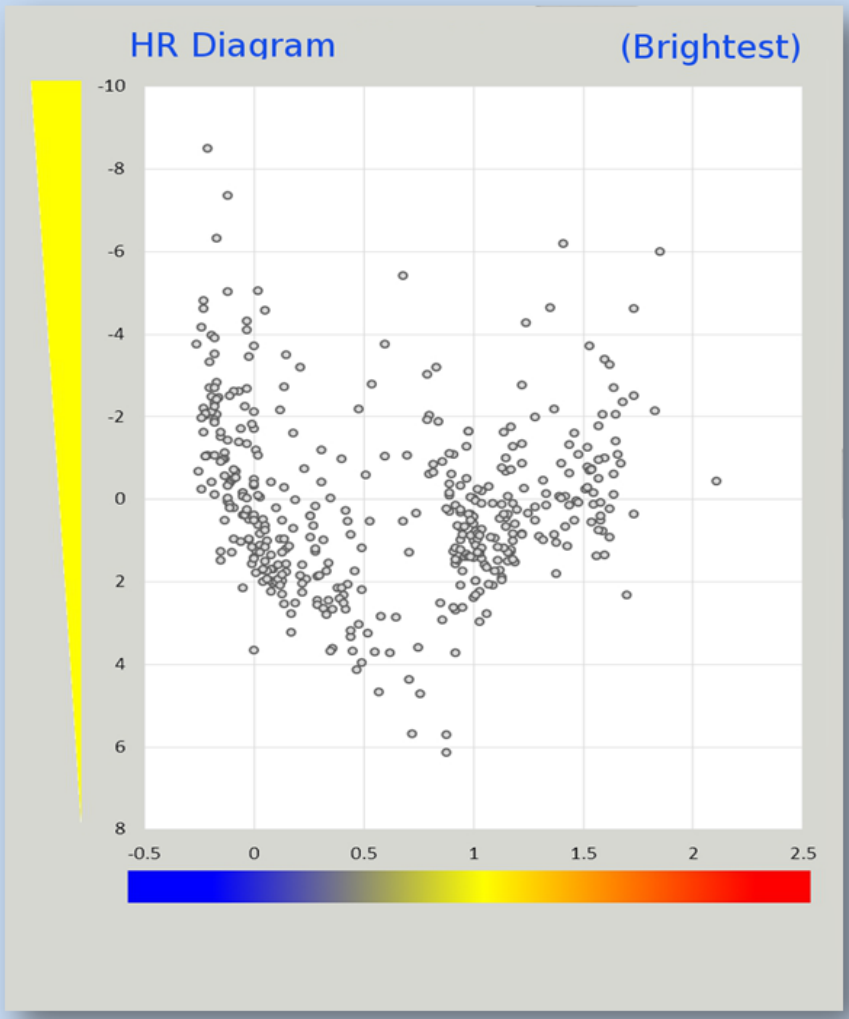
Question 2



1. What type of stars comprise the group towards the middle right of your HR diagram (ie. with B-V from about 0.7 to 2 and absolute magnitude from 3 to -7)?

Continuing with the concept that in any given group of stars there will be a predominance of those at the smaller end of the range. The stars centre right of the diagram are Categorised as Giants and are of the III classification (Around -1 to 1 M max)

2. What type of stars comprise the group towards the bottom left of your HR diagram (ie. with B-V from -0.2 to 0.7 and absolute magnitude from 6 to -2}?

This group of stars form the top of the Main sequence and this can be clearly seen in the composite diagram which follows.

3. What spectral types appear to be present on the main sequence?

The main grouping comprises B0v to F5v stars but with a bigger data sample type O stars would be found here too. The 0.0003% figure for population density for this type of star as discussed in the last question makes them very rare beasts indeed.

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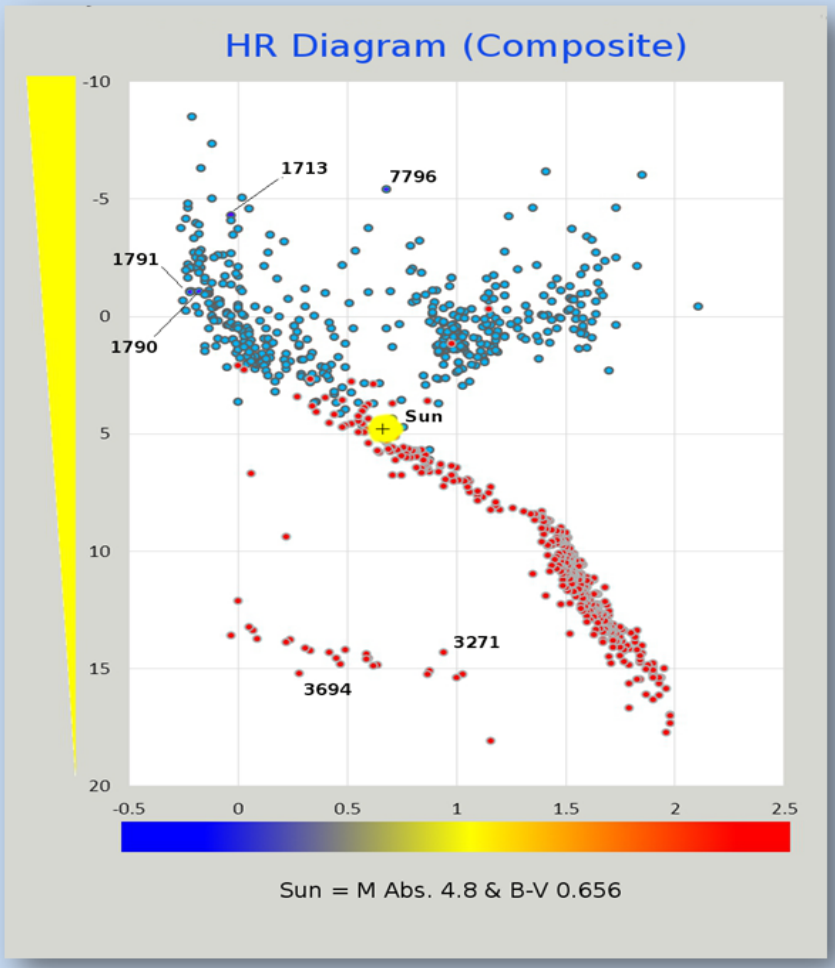
Question 3



Calculation Examples

Star ID	m App.	Paralax	Calculation	Distance	Calculation	M Abs
1790	1.64	0.029	Distance = 1/Paralax	34.48275862	M abs = m-5log(distance)+5	-1.0
1791	1.65	0.028		35.71428571		-1.1
1713	0.12	0.013		76.92307692		-4.3
7796	2.2	0.003		333.3333333		-5.4
7001	0.03	0.123		8.130081301		0.5
1708	0.08	0.073		13.69863014		-0.6

Which spectral type of star dominate in the galaxy as a whole? Why?

With a B-V index of 1.49 to 2.39, Spectral type M stars doninate the galaxy population (Easier to make small stars than it is to make big ones). It is suspected that there would be very many more represented if it were not for the fact that they are so difficult to find owing to their low absolute magnitude. This will probably change with instuments like the Spitzer Space Telescope and it's infrared

The sun has apparent visual magnitude -26.74, distance 1 Astronomical Unit, B-V colour index +0.65. Calculate the sun's absolute visual magnitude and plot its position on a print-out of the composite H-R diagram

Convert AU to Parsecs	Calculation	Calculation
4.84814E-06	M Abs = -26.74 - 5log(Distance)+5	**4.8**

List 2 main sequence, 2 giant, 2 supergiant and 2 white dwarf stars and identify them on your HR diagram (you will probably need to investigate the spectral type classification of stars i.e. what is an M0V star?).

	Giant (Group III)	Super Giant (Group I)	White Dwarf (Dxx)	What is an M0V star
Star1	1790 (B2III)*	1713 (B8Ia)	3694 (DXP9)	An M0v star is the hotest M class star on the main sequence
Star2	1791(B1III)*	7796 (F8Ib)	3271 (DC)	

Note: I have assumed that the Stars marked (*) although appearing to be on the main sequence their III grouping confers on them "Giant" status. I have chosen them to clarify this point. The more normal position for Giants on an HR diagram is to be found centred on the zero datum line on the M Abs. axis and between Spectral types G -M. Can I make the assumtion that in this area of the graph different groups of stars can occupy the same space? - Thanks Stacey

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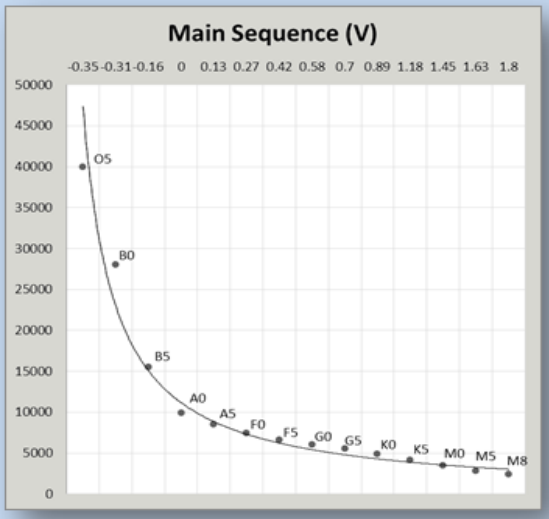
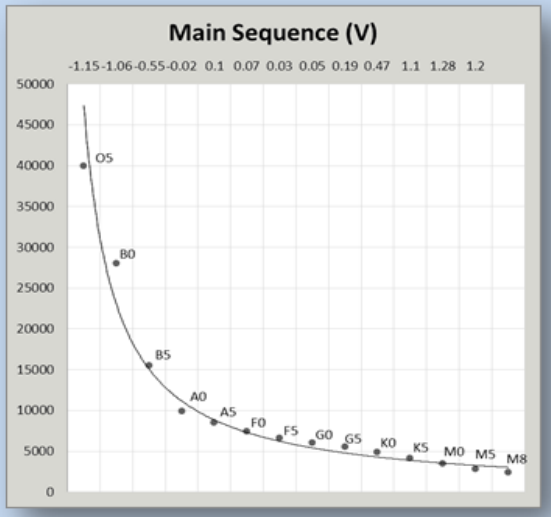
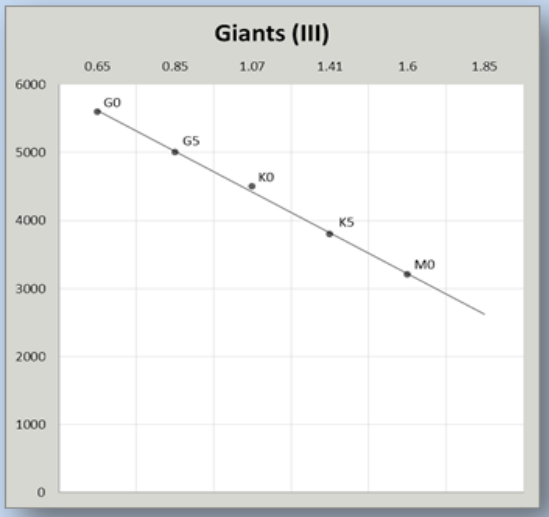
Plot calibration curves for effective temperature versus colour index



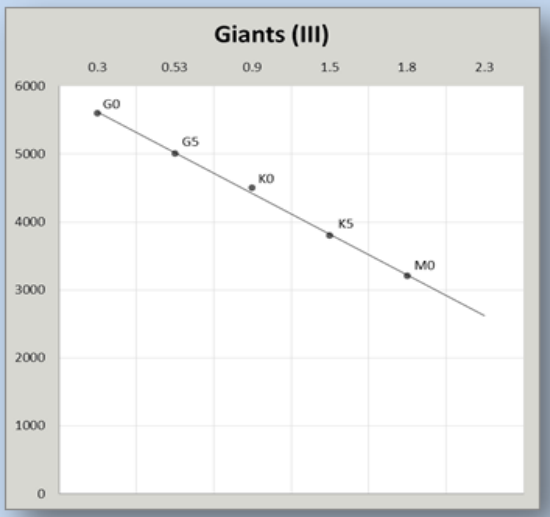
B-V versus Effective Temperature



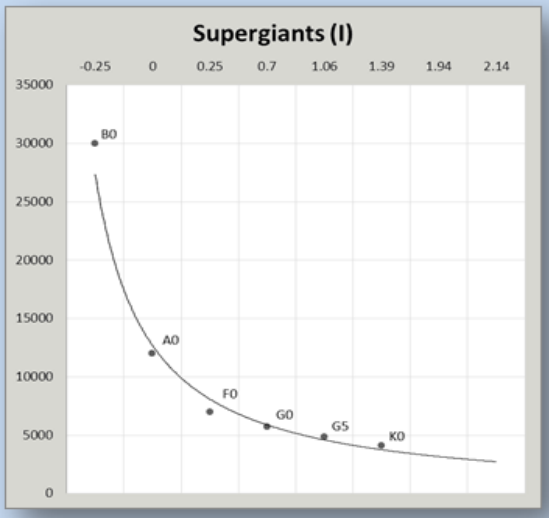
U-B versus Effective Temperature



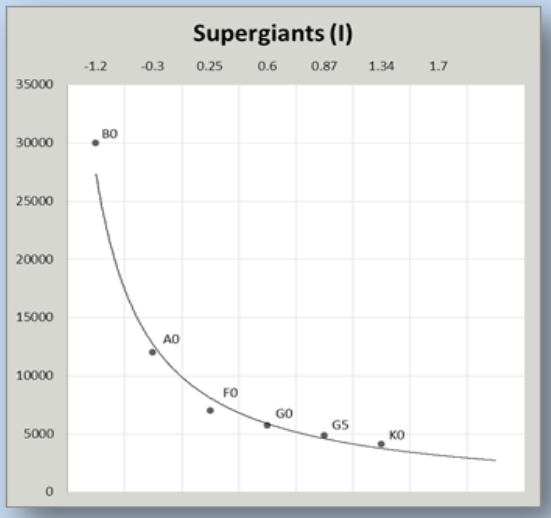
B-V versus Effective Temperature



U-B versus Effective Temperature



B-V versus Effective Temperature



U-B versus Effective Temperature

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Question 5

Star ID	Star Name	Spec. Type	Type	m - App.	M - Abs.	E - Temp	BC	MB - Abs	Stars Luminosity	x Sun R	Actual R	
3022 (N)	Vega	A0v	MS	0.03	0.59	10000	-0.4	0.19	2.69191E+28	2.218231	1542779	Km
1375 (N)		M7v	MS	16.78	17.72	3000	-2.5	15.22	2.61854E+22	0.024309	16906.8	Km
1713 (B)	Rigel	B8Ia	SG (I)	0.12	−6.7	10000	-1	-7.7	3.85532E+31	83.94729	58385341	Km
2061 (B)	Betelgeuse	M1-2Ia-Iab	SG (I)	0.5	−6.05	2800	-2.7	-8.75	1.01405E+32	1736.563	1.21E+09	Km
498 (N)		DA5	WD	13.05	13.59	7500	0.008	13.598	1.16643E+23	0.008209	5709.279	Km
NA	Sun	G2v	MS	-26.74	4.8	5200	-0.04	4.76	4E+26			

The 'BC' value for Star 498 is an estimate. Given that White Dwarfs are similar in size to the Earth the resulting radius confirms that it is quite close

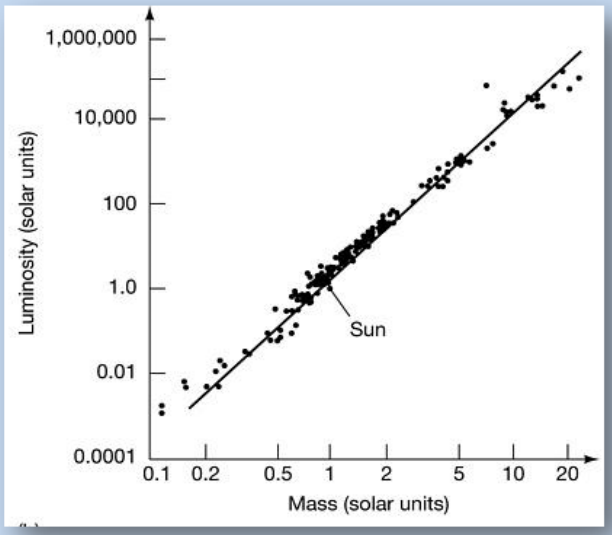
Calculating the Star to Sun Lum. Relationship

Star ID	Calculation	L x Solar L
3022 (N)		67.29766563
1375 (N)		6.54636E-05
1713 (B)	L(Star)/L(Sun)	96382.90236
2061 (B)		253512.863
498 (N)		0.000291608

Calculating Mass from M/L Diagram

Star ID	Data (Mass/⊙)	Actual
3022 (N)	2.1	2.13
1375 (N)	<0.1	0.1
1713 (B)	17	17
2061 (B)	~26	18-19
498 (N)	0.11	~0.7

Note: No data for the White Dwarf category of stars is given in the COLCAL data base so an estimate for the size 498 has been made based on the fact that the Chandrasekar limit for a white Dwarf is 1.4 Solar masses a 0.7 Solar Mass has been adopted



Mass Luminosity Relationship (Pearson Prentis Hall Inc Digram)

A feature of the mass Luminosity relationship is that it works for stars that are in the same group. For instance main sequence stars form a tight diagonal line when their Luminosity is plotted against their mass. It is therefore possible to determine either quantity if you know the other (main sequence). The problem with the given stars in this example is that not all of them are main sequence stars. Both 1713, and 2061 (Rigel and Betelgeuse respectively) are Type (I) Supergiants and 498 is a type DA White Dwarf. 1713 is probably a statistical coincidence but both 2061 and 498 depart from the otherwise accurate results confirming the fact that the M/L relationship diagram can only be used when they are in the same grouping (Main Sequence). From further reading it seems possible that if Mass Luminosity Relationship graphs are plotted for same group stars i.e. III and I then these graphs can be used in a similar way to determine unknown stars if they are in the same group.

Coursework Submission Title. Stellar Classification H-R 1

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I confirm that I am aware of the University Modular Framework Assessment Regulations (Section D Appendix C) regarding academic impropriety and that the work submitted conforms with those Regulations. I confirm that the coursework is my own and that all sources consulted have been appropriately acknowledged. I am aware that, in case of doubt, I may be required to take a viva voce examination.

Signature of Student: .....

Date: 15th. September 2010