Course and assignment number:
S281 01

Tutor Marked Assignment

Make sure you know how to complete and send in your TMA and PT3 form: detailed instructions are given in your student handbook (or supplement).

Covering: **Block 1, Chapters 1–3**
Cut-off date: **Friday 22 March 1996**

In all of the S281 TMAs we often suggest the sufficient length of TMA answers. These suggestions are broad guidelines: do not spend lots of time pruning your answer back to the exact suggested length. However, if your answer is coming out greatly in excess of the suggested length, then do check that you are answering the actual question asked! The exception to all this is Question 4 in this TMA, as newspaper editors tend to be very strict on their word counts!

Question 1

This question is based on Book 1 Chapter 1 (with information from Chapter 3 needed for b(i)), and carries 21% of the marks for the assignment.

(a) (i) *(5 marks)* Sketch an arc to represent part of the Sun's 'surface' and indicate beyond it the regions of the Sun's atmosphere. Do not draw the regions to scale (this is impractical) but indicate which are the more extensive layers. Label the regions and indicate the temperatures at the boundaries.

(ii) *(4 marks)* In about 50 words, describe the evidence for the high temperature of the corona.

(iii) *(8 marks)* List the features that vary with solar activity, and describe *how* they vary with activity.

(b) *(4 marks)* (i) What is the necessary condition for convection to be initiated in the interior of a star? (ii) What is the observational evidence for transport of energy by convection in the interior of the Sun?

Question 2

This question covers Book 1 Chapter 2, and carries 25% of the marks for this assignment.

(a) *(13 marks)*

Suppose that the Hipparcos satellite and ESO's VLT array make observations on a fictitious star 4 Smilii with the following results:

- stellar parallax = 0.205 arcsec
- angular diameter = 0.000 039 arcsec
- flux density received at 500 nm is three times that at 800 nm

(i) Calculate the radius of the star in metres and in solar radii – show all the details of your working.

(ii) With the aid of Figure 2.8 in Book 1, obtain the photospheric temperature of 4 Smilii. In one sentence, explain how you obtain the temperature. Estimate the spectral class corresponding to the temperature.

(iii) Calculate the luminosity of 4 Smilii in watts and in solar luminosities – show all the details of your working.

(b) *(5 marks)*

Sketch an H–R diagram, showing the regions occupied by main sequence stars, red giants, supergiants and white dwarfs. Plot the position of 4 Smilii and hence state the type of star it is.

(c) *(7 marks)*

Describe briefly (i) the composition of 4 Smilii *(1 sentence)*, (ii) what the immediately previous stage of 4 Smilii was likely to be *(2–3 sentences)*, (iii) what the immediate subsequent evolution of 4 Smilii is likely to be *(1–3 sentences)*.

Question 3

This question relates to Book 1 Chapter 3, and carries 29% of the marks for the assignment.

A star has a mass of $6M_{\odot}$.

(a) *(3 marks)* Show, by a sketch, how energy is transported in the interior of this star during its main sequence phase.

(b) *(10 marks)* Describe the various nuclear reactions that are important in a star of this mass. State where in the star (e.g. core, shell) and at what stage of its evolution these occur.

(c) *(12 marks)* Describe in outline the formation of such a star from a dense cloud. Your description should finish when the star joins the main sequence. How will the luminosity vary during this process?