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WEST MIDLANDS REGIONAL OFFICE
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Course and assignment number:

S281 01

Covering: **Block 1,
Chapters 1-3**

Cut-off date:

Friday 24 March 1995

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 relates to Book 1 Chapter 1, and carries 24% of the marks for this assignment.

(a) (10 marks) (i) In one sentence, state why the Sun must have some interior source of energy.

(ii) In about 150 words, describe two types of observation that provide particularly important, direct tests of theories of the solar interior. What is the outcome of each test? *neutrino oscillation*

(b) (14 marks) (i) From Figures 1.27 and 1.28 in Book 1 write down the temperature at the surface of the solar core within which nuclear reactions are taking place. In a couple of sentences state how you obtained the value you write down.

(ii) On the basis of this temperature, for the electromagnetic radiation at the core surface in (i),

- calculate the wavelength of the peak of the black-body spectrum – show your working, and state in which part of the electromagnetic spectrum the peak lies;
- calculate the photon energy corresponding to the peak wavelength – again show your working;
- sketch the black-body spectrum, showing the relative spectral flux density (no numerical values) versus wavelength in metres (on a linear scale).

Question 2

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

(a) (13 marks) Suppose that the Hipparcos satellite and European Southern Observatory's VLT Array make observations on a fictitious star 22 Waltonii with the following results

- stellar parallax = 0.085 arcsec
- angular diameter = 0.0018 arcsec
- flux density received at 500 nm is 2.4 times that at 700 nm.

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

(ii) With the aid of Figure 2.8 in Book 1, obtain the photospheric temperature of 22 Waltonii. In one sentence, explain how you obtain the temperature. Estimate the spectral class corresponding to the temperature.

(iii) Calculate the luminosity of 22 Waltonii in watts and in solar luminosities – show details of your working.

(b) (4 marks) Sketch an H-R diagram, showing the regions occupied by main sequence stars, red giants, supergiants, and white dwarfs. Plot the position of 22 Waltonii, and hence state the type of star it is.

(c) (8 marks) In about 150 words, explain briefly how observations of the spectral absorption lines of 22 Waltonii could provide independent estimates of (i) its photospheric temperature and (ii) its luminosity.

Question 3

This question relates to Book 1 Chapter 3, and carries 26% of the marks for this assignment.

(a) (9 marks) (i) From Equation 3.6 on p. 108 of Book 1, show that, for stars of similar composition

$$T/T_{\odot} = (M/M_{\odot})(R_{\odot}/R)$$

where T is the temperature in the core of a star, M is the mass of the star and R its radius. Solar quantities carry the subscript ' \odot '.