The Open University
Science Supplementary Material
S281 Astronomy and Planetary Science

Course and assignment number:

Computer Marked Assignment

S281 41

Make sure you know how to use the CMA form: detailed instructions are given in your student handbook (or supplement).
You are strongly advised to attempt every question in this assignment.
If you do not wish to answer a question, pencil across the 'don't know' cell ('?').
If you think that a question is unsound in any way, pencil across the 'unsound' cell ('U') *in addition to* pencilling across either an answer cell or the 'don't know' cell.
Note For each question, you **must** *pencil across* **either** *the required number of answer cells* **or** *the 'don't know' cell.*

Covering: **Block 1**

Cut-off date:
Friday 28 April 1995

PART A

This part relates to Book 1, Chapters 1–4, and carries 60% of the marks for this assignment.

Q1 Assuming that sunspots and the solar photosphere are ideal thermal sources, select from the key the *one true* statement about the ratio $F_{\lambda spot}/F_{\lambda phot}$, where $F_{\lambda spot}$ is the spectral flux density we receive from a sunspot, and $F_{\lambda phot}$ is the spectral flux density we receive from an equal area of photosphere (note that the > symbol means 'greater than', and < means 'less than'). Assume limb darkening is negligible. Pencil across *one* cell in row 1.

KEY for Q1

A $F_{\lambda spot}/F_{\lambda phot} = 1$ at all wavelengths
B $F_{\lambda spot}/F_{\lambda phot} > 1$ at all wavelengths
C $F_{\lambda spot}/F_{\lambda phot} < 1$ at all wavelengths
D $F_{\lambda spot}/F_{\lambda phot} < 1$ at visible wavelengths; $F_{\lambda spot}/F_{\lambda phot} = 1$ at non-visible wavelengths
E $F_{\lambda spot}/F_{\lambda phot} < 1$ at visible and *shorter* wave-lengths; $F_{\lambda spot}/F_{\lambda phot} > 1$ at all other wavelengths
F $F_{\lambda spot}/F_{\lambda phot} < 1$ at visible and *longer* wavelengths; $F_{\lambda spot}/F_{\lambda phot} > 1$ at all other wavelengths

Q2 During a total solar eclipse, why does the solar corona appear white, and the solar chromosphere appear red? Select *one* reason from the key, and pencil across *one* cell in row 2.

KEY for Q2

A The coronal emission lines occur at many visible wavelengths, whereas the chromospheric emission occurs mainly at the Hα wavelength.
B The corona is transparent over the whole visible spectrum, whereas the chromosphere is transparent only at red wavelengths.
C The corona scatters photospheric light roughly equally at all visible wavelengths, whereas the chromosphere scatters photospheric light mainly at red wavelengths.
D The corona scatters photospheric light roughly equally at all visible wavelengths, whereas the Hα wavelength is prominent in the visible wavelength chromospheric emission.
E An ideal thermal source at the corona's temperature has the peak in its spectrum at shorter wavelengths than an ideal thermal source at the chromosphere's temperature.

Q3 Observations of the Hα absorption line from the star Nekkar yield an observed frequency 3.1×10^{10} Hz higher than the laboratory frequency of 4.568×10^{14} Hz (i.e. a wavelength 0.044 nm shorter than the laboratory wavelength of 656.3 nm). What is the magnitude of the radial velocity of Nekkar? Select from the key the value closest to yours, and pencil across *one* of the A to F cells in row 3. Is Nekkar moving towards us, or away from us? Choose *one* option from the key, and pencil across *one* of the G and H cells in row 3.

KEY for Q3

A 15 000 km s^{-1}
B 13 200 km s^{-1}
C 29 km s^{-1}
D 20 km s^{-1}
E 12 km s^{-1}
F 0.044 km s^{-1}
G towards us
H away from us

$\Delta f = \sqrt{\frac{1+v/c}{1-v/c}}$

$1.000067^2 = \frac{1+v/c}{1-v/c}$

Q4 A binary system consists of two main sequence stars, of the same spectral class. The orbital period of the system is 74 years, and the semi-major axis of the orbit of one star with respect to the other is 32 AU. Calculate the mass of either *one* of these stars. Select from the key the value closest to yours, and pencil across *one* cell in row 4.

KEY for Q4

A $0.75M_\odot$
B $1.5M_\odot$
C $3.0M_\odot$
D $6.0M_\odot$
E $12M_\odot$
F $24M_\odot$
G There is insufficient information to answer this question.

$a^2\left(\frac{1-v}{c}\right) = 1+\frac{v}{c}$

$a^2 - a^2\frac{v}{c} = 1+\frac{v}{c}$

$a^2 - 1 = \frac{v}{c}(1+a^2)$

$\frac{v}{c} = \frac{a^2-1}{a^2+1}$

$(1.000134)\left(1-\frac{v}{c}\right) = 1+\frac{v}{c}$

$1.000134 - 1.000134\frac{v}{c} = 1+\frac{v}{c}$

$0.000134 = 2.000134\frac{v}{c}$