M1.(a) (i) λ_{max} T = 0.0029

λ_{max} = 180 × 10^{-9} m ✓

T = 0.0029 / 180 × 10^{-9}

= 1.6 × 10^{4} K ✓

Allow range for wavelength.
170nm to 190nm correct.
150nm to 200nm incorrect but treat as a.e.
Anything else treat as PE –first two marks not awarded.
Allow kelvin for unit. But not degrees kelvin.

3

(ii) P = σAT^4

A = P / σT^4 = 4.2 × 10^{24} / (5.67 × 10^{-8} × (1.6 × 10^4)^4) ✓

= 1.1 × 10^{15} m^2

r = √(A / 4π) = 9.5 × 10^6 m ✓

Allow c.e. for T from ai.
If formula wrong treat as PE – no marks awarded. Note: this is true if the incorrect equation for A is used within the power equation.

2

(b) (i) dwarf ticked

1

(ii) it has a high temperature ✓

Allow low power output for small.
Allow high power output for large.

but is relatively small, so it will have a low absolute magnitude ✓

Marks can be awarded for ruling out other two.

(this puts it into the bottom left region of the HR diagram)

If white dwarf not ticked in bi :–
Giant stars – cool and big.
Main sequence – either cool and small or hot and big for 2

marks.
Or 'middling temperature and size for 1 mark.

2

[8]

M2.(a) Apparent magnitude at a distance of 10pc

Allow "brightness".
Do not allow luminosity or magnitude.

1

(b) Absolute magnitude from 15 to -10
Temperature from 50 000K to 2500K

Allow 15 to -15.
Allow 50 000 to 3500 K.

2

(c) (i) S at 5700 K and abs mag 5

The position of S should be consistent with the scales on the axes. Allow ce on scale.
Allow 6000 for T.
If labels not present, or if only correct extreme values on scale, S should be to the right of and below the centre.

1

(ii) W at same abs mag as S, but further to left

Judgements on ii – iv should be based on the position of S. If S is not labelled, it should be based on where S should be.

1

(iii) X at same temperature as S but greater absolute magnitude

1

(iv) Y at same abs mag or above S, on the right hand side of the diagram

1

(d) Similar power output ✓
but is hotter ✓

Ref to $P = \sigma AT^4$ hence W must have smaller diameter than the Sun ✓

Allow luminosity for Power.

Answer must be supported to get the mark.

3

[10]

M3. (a) brightness (or apparent magnitude) of star from a distance of 10 pc **(1)**

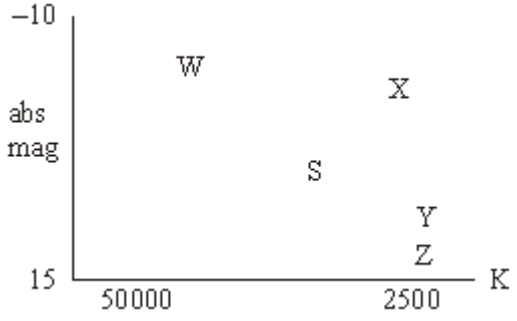
1

(b) (i) temperature from 50000 K to 2500 K **(1)**
absolute magnitude from +15 to –10 **(1)**

(ii) S at 6000 K, and abs mag 5 **(1)**

(iii) W above and to left of S **(1)**
X above and to right of S **(1)**
Y below and to right of S **(1)**
Z below and to right of S **(1)**

7



[8]

M4. (a) (i) main sequence correct **(1)**
Giants and Dwarfs correct **(1)**
OBAFGKM **(1)**

(ii) X at G, 5 **(1)**
line up to Red Giant, down to White Dwarf **(1)**

max 4

(b) (i) temperature and colour [or reference to correct spectral line] **(1)**

(ii) $\frac{330}{3.26} = 100\,(\text{pc})$ **(1)**

(iii) $m - M = 5 \log \frac{d}{10}$ gives $m - M = 5$ **(1)**

$M = -2.1$ **(1)**

(allow C.E. for value of d from (ii)

(iv) Matar is brighter (but at same temperature) **(1)**

(since $P = \sigma A T^4$), Matar must have larger A, therefore larger **(1)**

6

[10]