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

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M2.(a) Spectral class A✓

1

The temperature range for A class is 7500 K to 11 000 K✓

1

(b) Lowest value of apparent magnitude indicates the brightest star. ✓

1

Vega has the lowest apparent magnitude (so is brightest) ✓

1

(c) Closest of three stars is Altair✓

1

Using $m - M = 5 \log (d / 10)$

To give $0.77 - 2.21 = - 1.44$✓

1

And $d = 5.2$ pc✓

Allow ce for calculation of wrong star

1

(d) Deneb is the largest✓

No mark for unsupported answer

1

It has approximately the same temperature, but has a much brighter absolute magnitude and therefore greater power ouput ✓

1

To have a much greater power output for a similar temperature, it must have a greater area ✓

As $P = \sigma A T^4$

1

Allow alternative:
from position on HR diagram, from T and M,
Altair and Vega are main sequence stars
Deneb is a giant star
so Deneb largest.

(e) Using $\lambda_{max} T = 0.0029$

1

To give $\lambda_{max} = 0.0029 / 7700$ ✓

$= 3.8 \times 10^{-7}$ m ✓

1

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